

Original Research Article

Can the surgical Apgar score predict morbidity and mortality in general surgery?

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ABSTRACT

Background: The objective of the study was to evaluate the effectiveness of surgical Apgar score (SAS) in predicting morbidity and 30 day mortality in general surgical procedures and also to compare the predictability of the score in elective and emergency surgeries for outcome thereafter.

Methods: 120 patients undergoing general surgical procedures in JSS Hospital, Mysuru from November 2016 to April 2018 were included in the study. Necessary data was collected. Surgical Apgar score was calculated for each patient and analysis done.

Results: 75% of the patients included in the study were in the age group of over 40 years. Around 23% of the patients belong to age group >60 years. 18.25% of patients in the age group >60 years had a low Apgar score of <4. Whereas surgical Apgar score 9-10 was highest in the age group <40 years. Diabetes, hypertension, smoking were significantly associated with post-operative complications. 74.25% of the surgeries involved in the study were elective in nature. Amongst the 35 patients with an Apgar score of <4, major complications occurred in 33% and a 30-day mortality rate of 23% was observed. Morbidity was higher in emergency surgeries as compared to elective surgical procedures.

Conclusions: Surgical Apgar score is a simple and useful method of predicting the morbidity and the 30 day mortality of patients undergoing general surgical procedures. It is more sensitive in predicting the outcome in emergency cases as compared to the elective cases.

Keywords: Emergency surgeries, Morbidity, Surgical Apgar score, 30 day mortality

INTRODUCTION

Providers, including hospital teams and surgeons, endeavour to consistently lower the incidence of complications for a patient undergoing any surgical procedure. Recognizing patients at high risk or those having a high probability of developing peri-operative complication will significantly contribute to the

improvement of the quality of a particular operation and cost cutting in the healthcare.¹

The methods of surgical quality assessment available at present, such as the National Surgical Quality Improvement Program (NSQIP), developed by the American College of Surgeons, indirectly evaluate the surgical performance, i.e., by assessing the various risk factors in the pre-operative period and by comparing the

discrepancies between the observed complication rates and the expected rates to a particular treatment being provided.²⁻⁴

In the operation theatre, most surgeons' rely on "gut feeling" instead of objective assessment regarding the course of the operation and the post-operative prognosis.⁵

Several models available for risk prediction have incorporated various variables for early prediction of postoperative morbidity and mortality. Nevertheless, a clear consensus on the ideal or the most applicable postoperative risk assessment model is still elusive.⁶

It was in 1953 that Virginia Apgar formulated a scoring system for evaluating the condition of a newborn. In order to make a simple, impersonal and direct method of risk grading available to surgeons, a surgical Apgar score (SAS) was described by Gawande et al.⁷ The key to reducing postoperative morbidity and mortality is by effective perioperative management of patients. This requires objective assessment of the patient with risk scoring systems. Risk scoring system serves to assess a patient's risk of adverse outcome based on the severity of illness which is derived from patient data documented at an early stage of hospital stay. Several parameters recorded in the operation theatre were assessed, and three variables were found to be independent predictors of complications in the postoperative period including death. These variables were – patient's lowest heart rate (HR) during surgery, estimated blood loss (EBL) during the procedure and the lowest mean arterial pressure (MAP). These three predictors have helped build a strong predictive model for categorizing patients who are at increased risk of developing complications in the postoperative period and death following general surgical and vascular procedures.⁷

This score's simplicity, availability in real time, immediate applicability in decision making and inexpensive nature make it a powerful tool for early recognition of complications.⁷ The SAS has been

validated in the west but studies are less in numbers in our country.

The ability of the SAS to predict the risk of post-surgical complications in patients undergoing general surgical procedures has been evaluated in this study.

METHODS

Patient cohort

120 patients of JSS Medical College and Hospital Mysuru from November 2016 to April 2018 presented for elective and emergency surgeries were considered for this study. Patients over the age of 18 years undergoing general surgical procedures under general, epidural or spinal anaesthesia were eligible for inclusion. Surgeries not requiring intensive perioperative monitoring were excluded from the study.

A detailed clinical history was taken from all the patients consented for study and thorough physical examination was done. Patients were evaluated preoperatively with routine haematological and radiological investigations needed for the surgery. Intra operative details such as blood pressure and heart rate were recorded and the surgical Apgar score calculated. The patients were followed up post operatively and observed for any complications till 30 days and the 30 day mortality and morbidity were tabulated and analysed.

Parameters monitored

- Estimated blood loss
- Lowest mean arterial pressure
- Lowest heart rate during the surgical procedure.

The surgical Apgar score is calculated as shown in the Table 1. The cumulative scores are separated into 5 categories as follows:

0-2, 3-4, 5-6, 7-8 and 9-10.

Table 1: Surgical Apgar score.

Surgical apgar score Variables	No. of points				
	0	1	2	3	4
Estimated blood loss, ml	>1000	600-1000	101-600	<100	-
Lowest mean arterial pressure, mmHg	<40	40-54	55-69	>70	-
Lowest heart rate/min	>85	76-85	66-75	56-65	<55
1. Occurrence of pathologic bradyarrhythmia, including sinus arrest, arterioventricular block or dissociation, junctional or ventricular escape rhythms and systole, also receives 0 points for lowest heart rate					
2. Lower the cumulative score, higher the chances of major complication rates and 30 days mortality rates.					

Database management and statistical analysis were performed using Microsoft Excel and SPSS-20.

Data such as lowest heart rate and Lowest mean arterial pressures reached during the procedure were collected

from the anesthesiologist's records (electronic/ manual). Estimated blood loss was calculated using the formulae.⁸

Blood loss = $[(EBV \times (Hi - Hf)) / ((Hcti + Hctf)/2)] + (500 \times Tu)$ where:

- Estimated blood volume (EBV) is assumed to be 70 cm³/kg
- Hi and Hf represent pre and post operative haemoglobin
- Hcti and Hctf represents pre and post operative hematocrit, and
- Tu is the sum of autologous whole blood (AWB), packed red blood cells (PRBC), and cell saver (CS) units (FFP, Cryoprecipitate, and Apheresis) transfused. With an estimate of the probability of the morbidity and mortality status derived from the Apgar score, patients are followed up for occurrence of any major complications or death till 30 days postoperatively (30 day mortality). Regular follow ups of all the patients in the study were performed in the OPD and especially the group with low Apgar scores. Some of the patients were followed up by telephonic interview.

Relevant clinical investigations either invasive or noninvasive were performed where physiological parameters indicated organ complications. The following events were considered as major complications:

- Acute renal failure.
- Bleeding that requires a transfusion of 4U or more of red blood cells within 72 hrs after surgery.
- Cardiac arrest requiring cardiopulmonary resuscitation.
- Coma of 24 hrs or longer.
- Deep vein thrombosis.
- Myocardial infarction.
- Unplanned intubation.
- Ventilator use for 48 hrs or more.
- Pneumonia.
- Pulmonary embolism.
- Stroke.
- Wound disruption.
- Deep or organ-space surgical site infection.
- Sepsis.
- Septic shock and
- Systemic inflammatory response syndrome.

RESULTS

In our study a total of 120 patients above the age of 18 years were included, gender wise, male patients constituted 51% of the surgical population. Patients with age group of more than 40 years constituted the majority of the surgical population, being about 74%.

Almost 12 patients out of 35 in the age group of more than 51-60 years had a low surgical Apgar score of less

than 4, whereas majority of patients (6 out of 13) with score 9-10 belonged to age group <40. Among the 35 (29%) patients with an Apgar score of <4, major complications occurred in 33% and a 30 day mortality of 23% was seen. In contrast, among 13 patients with a score of 9-10, no morbidity and mortality were noted (Figure 5 and 6).

2/3rd of the cases in this study were operated on an elective basis, with emergency procedures constituting the remaining 1/3rd (Figure 1). The complication rates were higher in patients undergoing alimentary tract surgeries as compared to other surgeries (60%) (Figure 4). The findings were similar in the case of laparotomy with the mortality rate being higher in emergency procedures than in elective procedures.

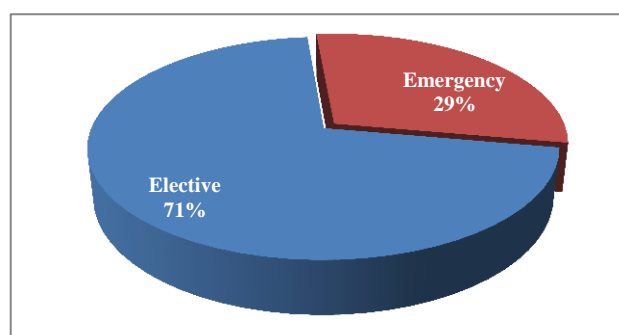


Figure 1: Type of surgery.

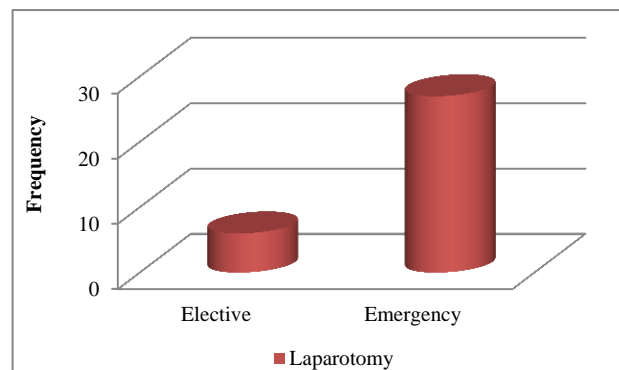


Figure 2: Types of laparotomies.

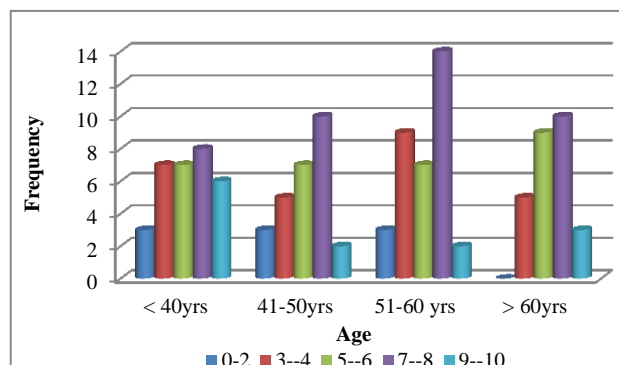
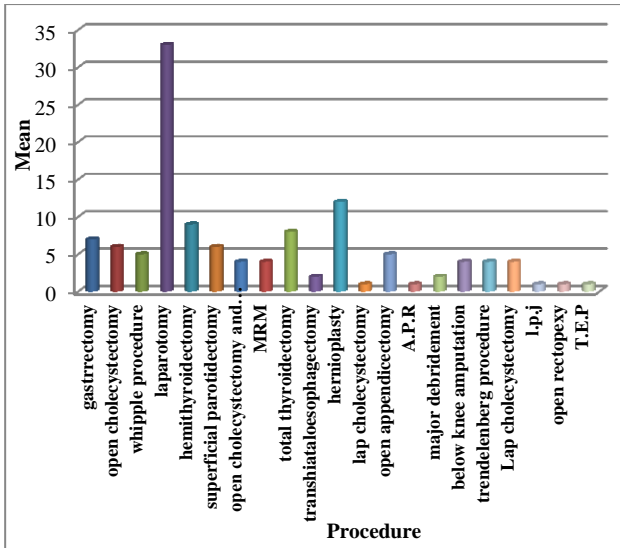


Figure 3: Distribution of Surgical Apgar score and age group.



MRM: Modified radical mastectomy, APR: Abdominoperineal resection, LPJ; Lateral pancreaticojejunostomy, TEP: Total extraperitoneal repair surgical apgar score with major complications and mortality.

Figure 4: Types of surgeries.

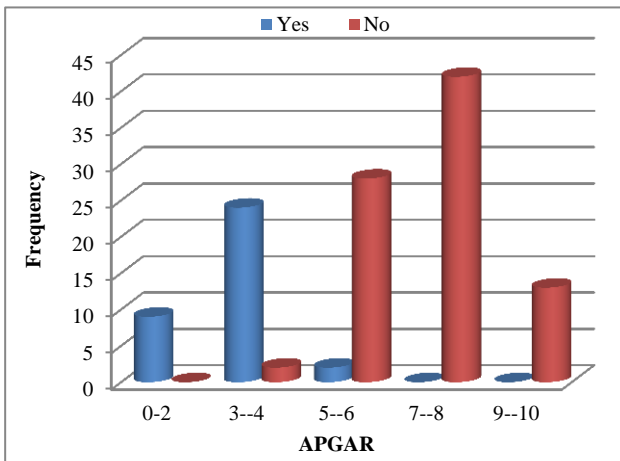


Figure 5: Surgical Apgar score with major complications.

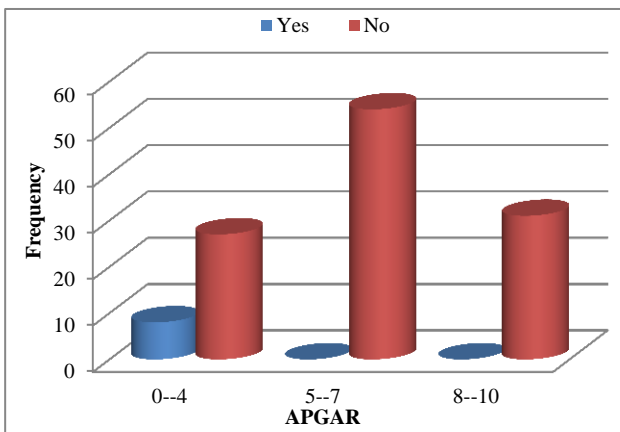


Figure 6: 30 day mortality distribution with Apgar score.

It is evident from this study that the 30 day mortality is seen to be higher in emergency surgical groups when compared with the elective surgical groups with respect to all categories of Apgar score.

DISCUSSION

Prognostic scores are in vogue in many areas of medicine and aim to provide information that could personalise treatment to yield patient benefit. Several surgical clinical risk scoring systems are in use for predicting surgical outcomes such as the ASA (American Society of Anaesthesiology) grading system, POSSUM (physiological and operative severity score for enumeration of mortality and morbidity) and APACHE (acute physiological and chronic health evaluation). However, these scores are not easily calculated at the bedside, require extensive data and rely on laboratory values that are not uniformly collected, thereby rendering them impractical for routine use. In contrast, the SAS is a simple, objective and economical ten-point postoperative prognostic scoring system based on three easily recordable intraoperative variables.

Our study evaluated 120 patients who were appropriately assessed and managed according to standard guidelines for the respective disease. 51% of the patients in our study were male patients. Several studies on this scoring system by Gawande et al and Scott et al show a female preponderance of 56% to 65% in various study cohorts.⁹ However, no association has been noted between gender, the Apgar score and the postoperative prognosis in these studies. 75% of the patients were in the age group of over 40 years. About 25% patients belonged to the below 40 years age group. Earlier studies have shown an average age distribution of 55.3 years to 63.6 years.⁹

About 23% of patients (27 patients of 120) belong in the age group >60. About 18.25% of patients (5 patients of 27) in the age group >60 years had a low Apgar score of <4 (Figure 3).

12 patients in the age group of 51-60 had an Apgar score <4.

Surgical Apgar score 9-10 was highest 46.8% (6 out of 13 patients) in age group <40 years. 3 out of 31 patients (9.6%) of age <40 years had Apgar score <2. Most studies on SAS have implicated long surgical duration as an important factor in the occurrence of major complication, probably reflecting on the extensive nature of the disease and complexity of surgery.

The most common comorbidities noted were hypertension (31.6%), diabetes (20%), smoking (10%), pulmonary disease (8%), alcohol intake (6.66%).

Hypertension, diabetes, smoking and pulmonary diseases were significantly associated with post operative complications and death (p<0.05) min the study. No

significant difference in the occurrence of the complications or 30 day mortality noted with cancer, steroid therapy, CVA and obesity as compared with Scott et al.¹⁰ A cohort study of 303 colectomy cases by Gawande et al, showed no significant correlation with BMI, cardiovascular disease, pulmonary disease, preoperative sepsis, malignancy, or blood transfusion.¹¹

As shown in Figure 1, 74.25% of surgeries in this study were elective in nature. 25.75% of surgeries, in this study were emergency in nature amounting to 1/3rd of the total cases. Of the 120 cases, 33 cases were laparotomies, with elective laparotomy constituting 18% (6 cases of 33) and emergency being 82% (Figure 2). Of the 120 patients, there was a 6.6% (8 patients) 30 day mortality rate. Complications were noted in 35 patients. No complication was noted in 71% of the patients studied. Mean surgical Apgar score was 6.75. The difference in surgical outcome between patients in different score groups was also statistically significant.

Due to the lacunae in the reporting of peri-operative complications, the P-POSSUM score has shown to both over and under predict the mortality rates in different settings.¹²

A significant association between low SAS scores and immediate post-operative ICU admission has been seen in a study conducted at Columbia University, New York.¹⁴

The SAS has its own limitations. Calculation of score relies on EBL which may be imprecise as broad categories have been used to calculate the amount of blood loss (0-100 ml, 101-600 ml, 600-1000 ml, >1000 ml) and depend upon observers' range of precision. Another hypothetical limitation lies in the fact that perioperative haemodynamics is affected by anaesthetic drugs and interventions and differ from individual to individual, thereby altering the computation of the SAS. Finally other significant predictive perioperative variables such as patient age, comorbidities involving the cardiac and renal systems, intravenous fluid volume administered, surgical time, functional status and chronic steroid use are not included in SAS, thereby excluding potential viable predictors. However it is worth mentioning here that the strength of SAS is largely due to its simplicity.

CONCLUSION

Prognosis prediction in surgical patients paves way for effective interventions in the postoperative period as the calculation of SAS provides real time and reliable information about postoperative risk. The prognostic value functions to alert the surgeon to proceed with further resuscitation or order additional diagnostic tests. Patients with scores less than 4 are considered to be at high risk for decompensation and need intensive monitoring. Patients with scores below 6 are predisposed

to have major complications and those with scores above 7 have been found to have minimal complications, not in need of special care. Complication rates are higher in patients with comorbidities such as hypertension, diabetes mellitus and anaemia. Emergency surgery carries higher complication risks when compared to elective surgeries. SAS scoring system has a major role in risk stratification and personalizing treatment to optimise surgical outcomes.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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